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CARBURETION, HEAT REJECTION, AND WEIGHT DATA OF U. S. MODEL W-1 ENGINE

(POWER PLANT SECTION)

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INDEX.

CARBURETION, HEAT REJECTION, AND WEIGHT DATA OF U. S. MODEL W-1 ENGINE.

OBJECT.

The object of this test was to secure a carburetor setting which would give an actual brake horsepower of the United States model W-1 engine of 710 at the normal revolutions per minute of 1,700 with a specific fuel consumption of 0.51 to 0.53 pound per horsepower-hour. Also to secure data on the rejection of heat to the cooling water and the weight of the engine and cooling water.

RESULTS.

The results of this test are given by the included data and curves. Data were secured on several carburetor settings to cover any contingency that may arise when the engine is mounted in an airplane.

CONCLUSIONS.

The results show that it is a characteristic of the carburetors to give a very low specific fuel consumption when throttled on propeller load. With the present air bleed, a carburetor setting which gives a fuel consumption of 0.51 to 0.53 pound per brake horsepower-hour at 1,700 revolutions per minute full throttle, will give a fuel consumption of approximately 0.465 pound per brake horsepower-hour at 1,500 revolutions per minute. It is, therefore, recommended that these carburetors be given a thorough trial in an airplane before the final setting is definitely established. The following setting is recommended for use until actual airplane tests are made: Choke, $1\frac{9}{16}$ inches; main jet, No. 48; air bleed, No. 45.

DESCRIPTION.

This engine is the fourth model "W" engine assembled and is numbered A. S. No. 95012. This engine differs from the original model "W" tested in the following respects: It has a new design, strengthened crank case; new design gear case with ball bearings replacing the orginal bronze; new magneto bracket (see fig. 6) mounting four instead of three magnetos; new intake tubes through the crank case; new breather tubes; new enlarged oil leads to the cam shaft; reworked pistons with enlarged oil grooves; and new type NA-S6 carburetors.

These carburetors are single barrel, single venturi carburetors with the float chamber at the side of the barrel. Their operation is the same as that of all Stromberg models, that is, a common air-bleed jet and accelerating well with a separate idling system which takes its fuel supply from around the accelerating well. The mixture control is obtained on the "auxiliary air port" principle, by means of butterfly valves which admit air to the mixture passage above the venturis, thus "leading out" the mixture. For a detailed description of the principle of operation of this control see Air Service Information Circular, volume 3, No. 292. The accelerating well, discharge nozzle, fuel metering jet, idle tube, and air-bleed metering jet are all removable and can be made any size.

METHOD OF TEST.

The engine was mounted on the dynamometer in the power plant laboratory at McCook Field, Dayton, Ohio. The first dynamometer run was started on January 6, 1922, and the concluding one made on January 23, 1922.

For a detailed description of the method of making runs and taking readings see Engineering Division report, serial No. 1507.

A run was first made to determine the horsepower and specfic fuel consumption with the setting that was then in the carburetors on the engine. This setting was: Choke, $1\frac{5}{8}$ inches; main jet, No. 46; and air bleed, No. 45. Since the horsepower will show a slight variation with a change in specific fuel consumption, a metering jet size was determined which gave the normal fuel consumption (0.510 to 0.530 pound per brake horsepower per hour at full-throttle normal speed). The engine was then throttled to give the desired brake horsepower (710) at normal speed and the manifold vacuum recorded. From the relation of this vacuum to that at full-throttle normal speed a choke size was calculated to give the required horsepower without throttling and verified by test. A metering jet size was then determined to be used in conjunction with this choke, which gave the desired specific fuel consumption at full throttle. (See fig. 14.)

A standard carburetion run was then made (see pp. 34 and 35 of report, serial No. 1507 mentioned above), the results of which are shown on the datum sheets (series A) and curve sheets. As will be noticed from the corresponding curve, figure 14, the specific fuel consumption has a decided tendency to drop when the engine is throttled on propeller load. It was, therefore, decided to obtain data on the carburetor characteristics when using larger metering orifices so these data (series A) would be available in case it was found necessary to resort to richer settings when the engine was in an airplane. The extent of the tendency of the fuel consumption to drop when the throttle is closed can be regulated somewhat by varying the size of the air-bleed orifice. This was done and different combinations of fuel-metering orifice with air-bleed orifice were tried and the data (series B and C) recorded. (See pp. 15 and 16.)

The regular carburetor head-test runs were made and the data (series D) are given on page 16 (Subsequent to the completion of this test it was decided to obtain the head at which the carburetors would flood, both with the engine running and not running. The engine used throughout this test at the time this decision was reached had been removed from the dynamometer but a duplicate

was available at the torque stand in engine A. S. No. 94626. This engine was equipped with NA–S6B carburetors (single venturi, float chamber depression mixture control). These carburetors have similar floats and float arms and the same area of needle valve and seat as the NA–S6 carburetors used on engine A. S. No. 95012. On March 7, 1922, the test was made on these carburetors, the data (series E) from which are given on page 16.

On completion of the carburetion runs while the engine was still on the dynamometer, a set of runs was made to obtain the cooling-water data. These runs were standard full-power runs at speeds of 1,600, 1,700, and 1,800 revolutions per minute, readings of water flow through the engine being taken in addition to the standard readings. The water flow was determined by means of water venturis which had previously been calibrated and the heat data are figured from temperatures which were read with thermometers in the cooling-water line. These thermometers had been previously calibrated and were placed in the cooling-water line with the bulbs in direct contact with the passing water. Complete data (series F) from the cooling-water runs are given on page 17.

At the completion of the various runs the engine was removed from the dynamometer and the weight obtained, together with the weight of the cooling water necessary to fill the cooling spaces in the engine.

Following this a complete set of photographs of the assembled engine was made.

The calibration of the water venturis showed that within the limits of accuracy of the readings, the two venturis were practically identical in flow and that, when used together in parallel, the calibration curves of the individual venturis still held true. The water-temperature thermometers were placed as close to the engine as possible, one in the water inlet and the other in the outlet.

The weight data given in the next column are self-explanatory.

For convenience in reference, the data from the various runs are segregated serially as follows:

Series A: Carburetor runs with No. 45 air bleed, different size fuel-metering jets.
Series B: Carburetor runs with No. 38 air bleed.
Series C: Carburetor runs with unrestricted air bleed, different size fuel-metering jets.
Series D: Carburetor head-test runs made on dynamometer.
Series E: Carburetor head-test runs made on torque stand.
Series F: Heat rejection to cooling-water runs.

ANALYSIS.

Examination of the data shows that in horsepower and fuel consumption this engine is sensitive to air-temperature changes. This was very noticeable during the test. The average air temperature for the majority of these runs lies between 20° and 40° F. These temperatures are considerably below the average of operation, especially on the dynamometer. Therefore, the readings of specific fuel consumption as given throughout this report will probably be considerably increased if the engine is run at a normal air temperature of 60°. It will also be noticed that the brake horsepower is high with the lower temperatures, and this will also be affected and drop when the engine is run under a normal intake air temperature.

The carburetors, as far as could be determined on the dynamometer stand, give smooth running on propeller load at all speeds with all settings from idling (200 to 300 revolutions per minute) to full throttle. As will be seen from an examination of the data, the operation of the air-port type of mixture control tends not only to reduce the actual fuel flow, but also to increase the horsepower by increasing the volumetric efficiency. This condition previously had been observed on other tests of the air-port type of control.

In analyzing the results of the flooding test of the carburetors, conducted at the torque stand (see series E data, p. 16) it should be remembered that in these carburetors the idle system secures its fuel supply from around the accelerating well after the fuel has passed through the main metering orifice. The flooding of these carburetors takes place when the level in the well reaches the height of the outlet passages in the discharge nozzle. The action of the idle drawing on this fuel will have the effect of lowering the fuel level in the well. The extent of this effect is not known and it is problematical as to how much of the marked increase in head necessary to flood the carburetors with the engine running at idling speed is due to this and how much, if any, is due to the better seating of the needle valve due to the vibration.

As noted previously, the cruising-speed specific fuel consumption of this engine is good, With the No. 49 metering orifice and No. 45 air bleed (fig. 16) the specific fuel consumption at 1,500 revolutions per minute is 0.450 pound per horsepower hour. It is doubtful if the engine when mounted in an airplane will run smoothly under all weather conditions on a mixture ratio lean enough to give this consumption. The curves (from series C) on the bottom of figure 16 look to be better probably than the ones (from series A) with the smaller air bleed. Only a trial in the air will determine this, but the cruising-speed fuel consumption of this engine should be well below 0.500 pound per horsepower hour, and this is considered a good rate of consumption. It is believed that enough data are here included to provide for any setting required when the engine is mounted in an airplane.

WEIGHT DATA OF MODEL W–1 ENGINE.

[Date, Jan. 25, 1922.]

		Pounds.
Gross weight of engine as weighed (includes weight of water, some undrained oil and supporting tackle)		1,932
Weight of undrained oil	13.5	
Weight of supporting tackle	24.0	
Total		37.5
Net weight of engine and cooling water		1,894.5
Weight of cooling water necessary to fill engine		80.0
Net weight of engine[1] dry		1,814.5

[1] This engine was weighed after completion of the test and undoubtedly was heavier by a few pounds than a clean engine from the assembly shop would be.

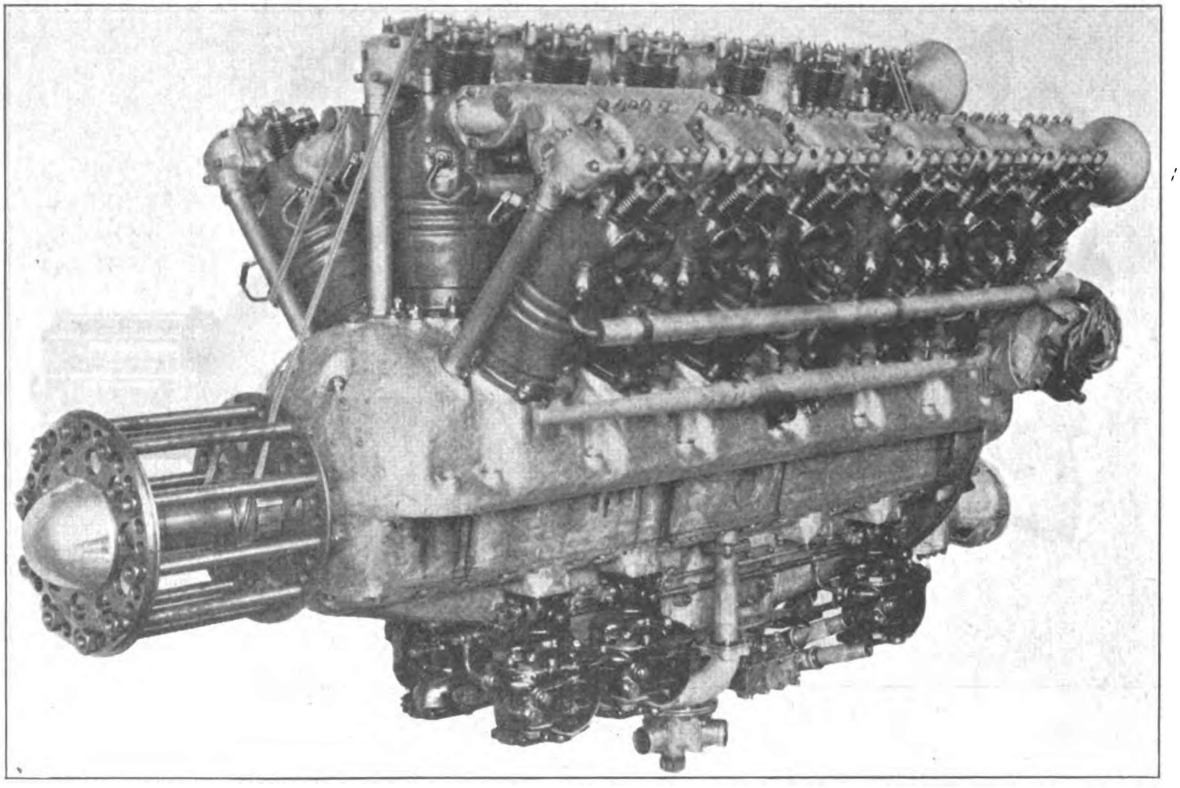

FIG. 1.—Three-quarter front view (left side).

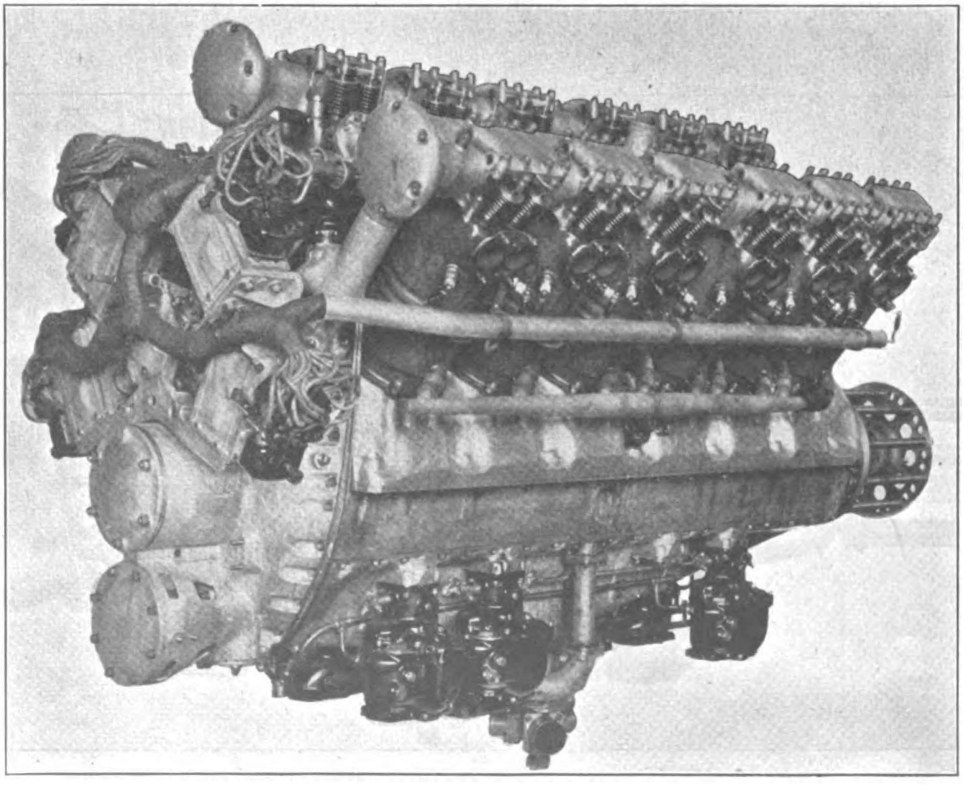

FIG. 2.—Three-quarter rear view (right side).

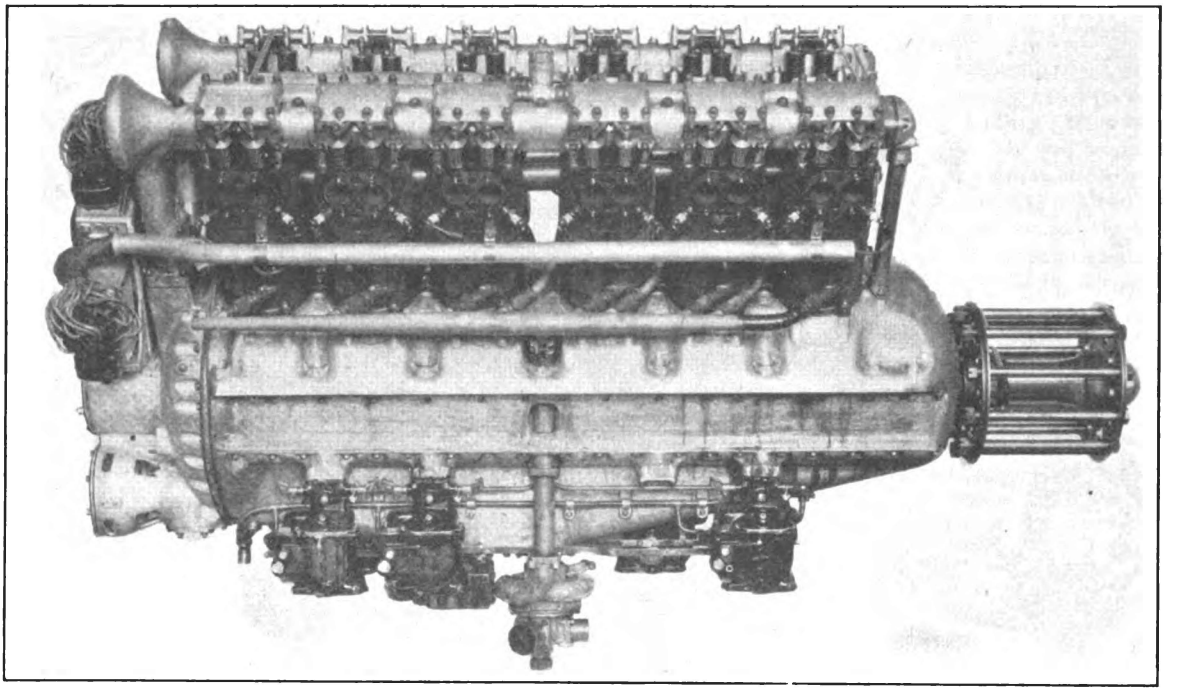

FIG. 3.—Right side view.

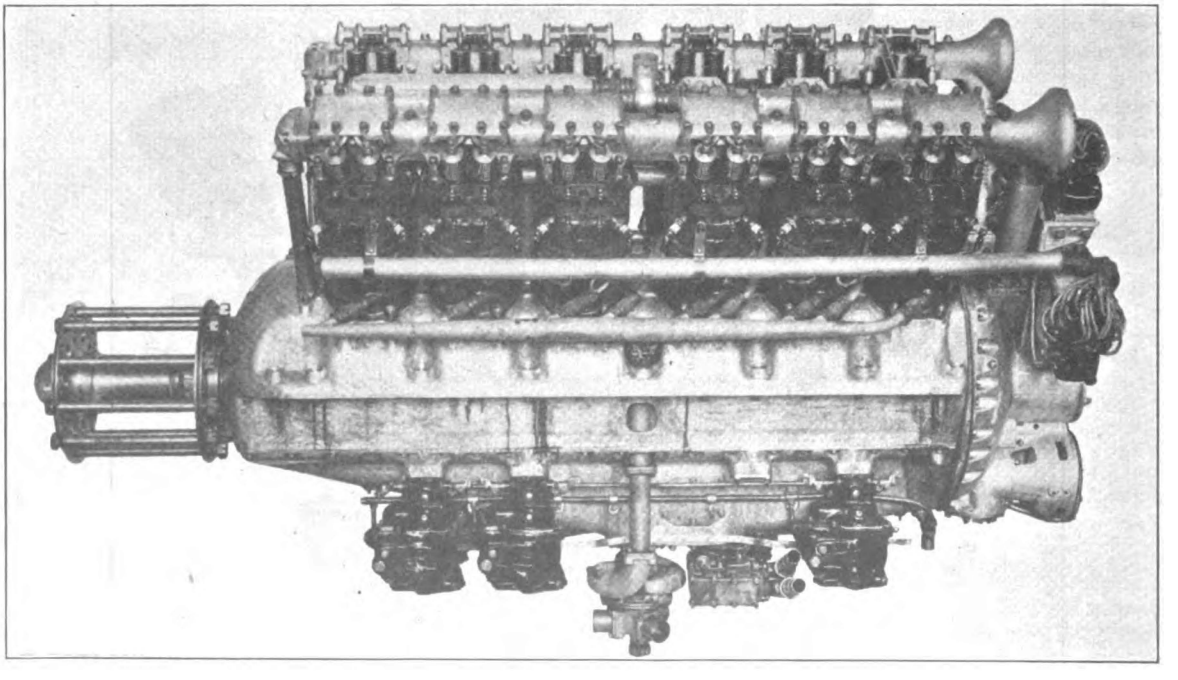

FIG. 4.—Left side view.

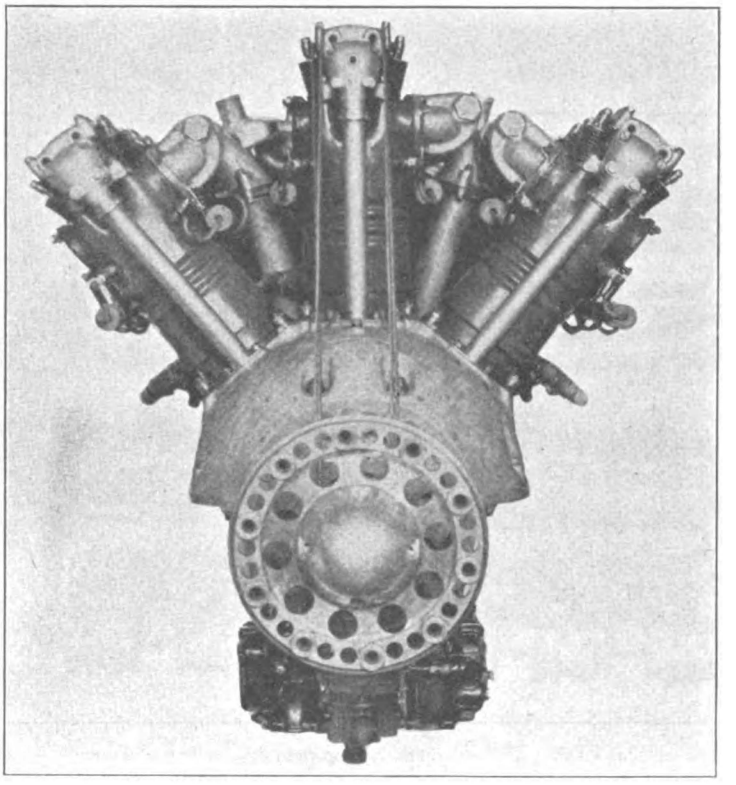

FIG. 5.—Front end view.

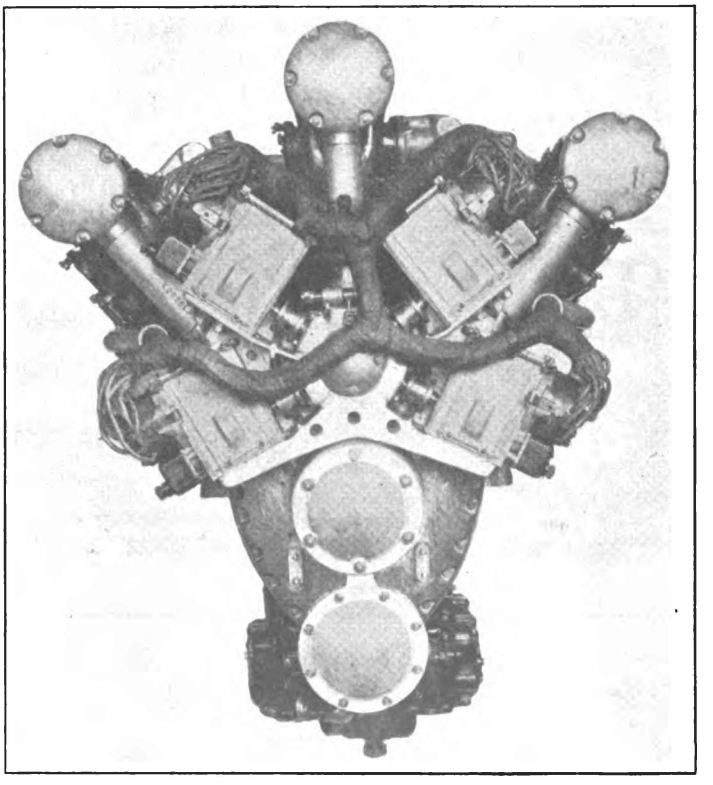

FIG. 6.—Rear end view.

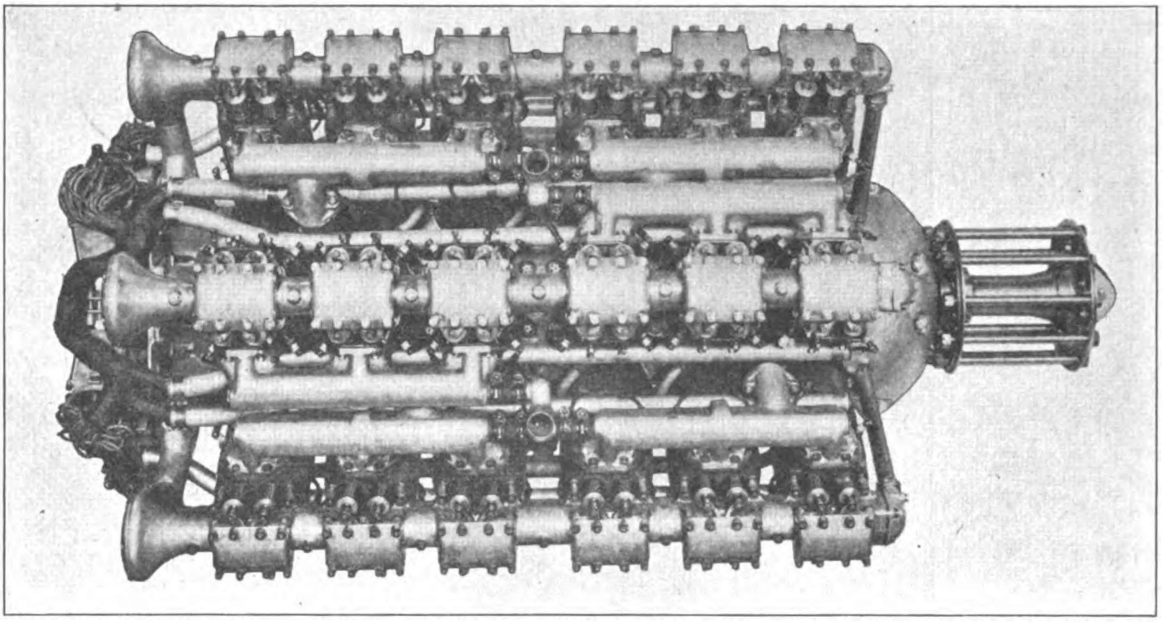

FIG. 7.—Top view.

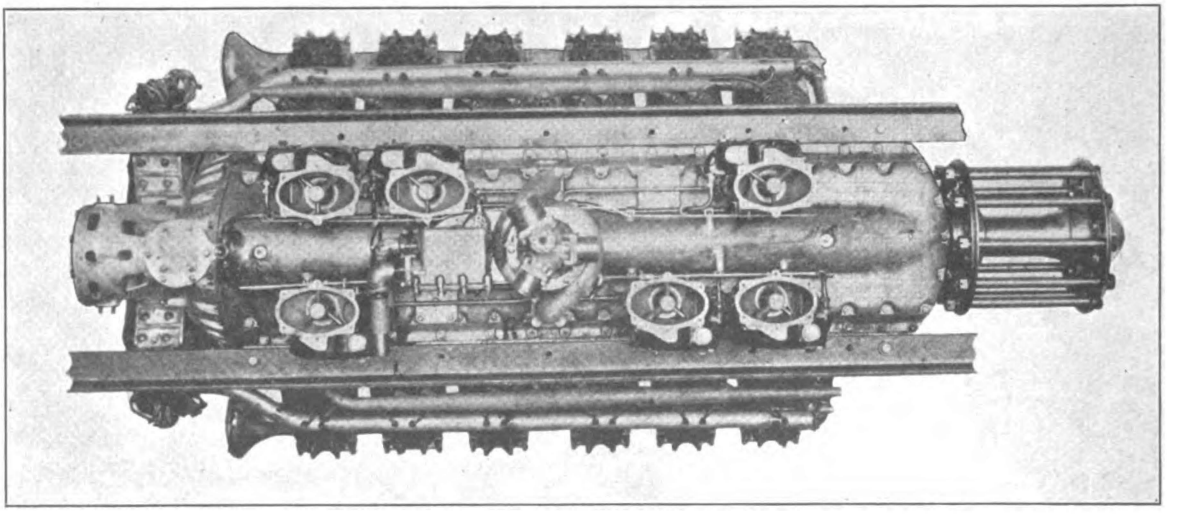

FIG. 8.—Bottom view.

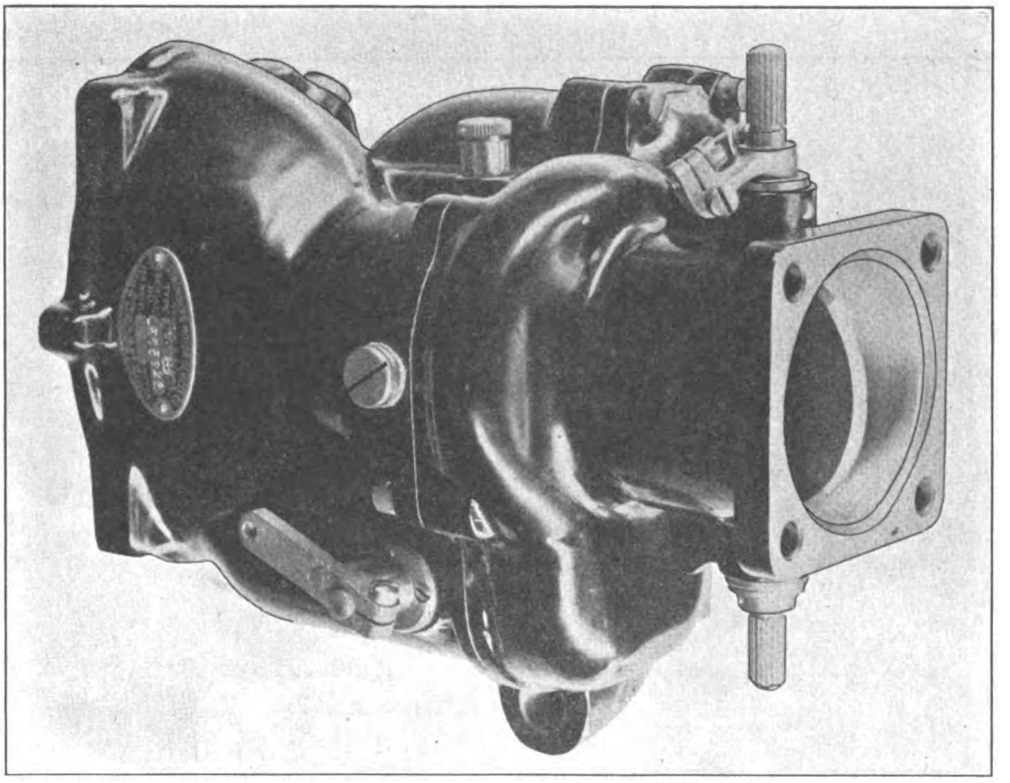

FIG. 9.—Stromberg NA-S6 carburetor. Side (air scoop) view.

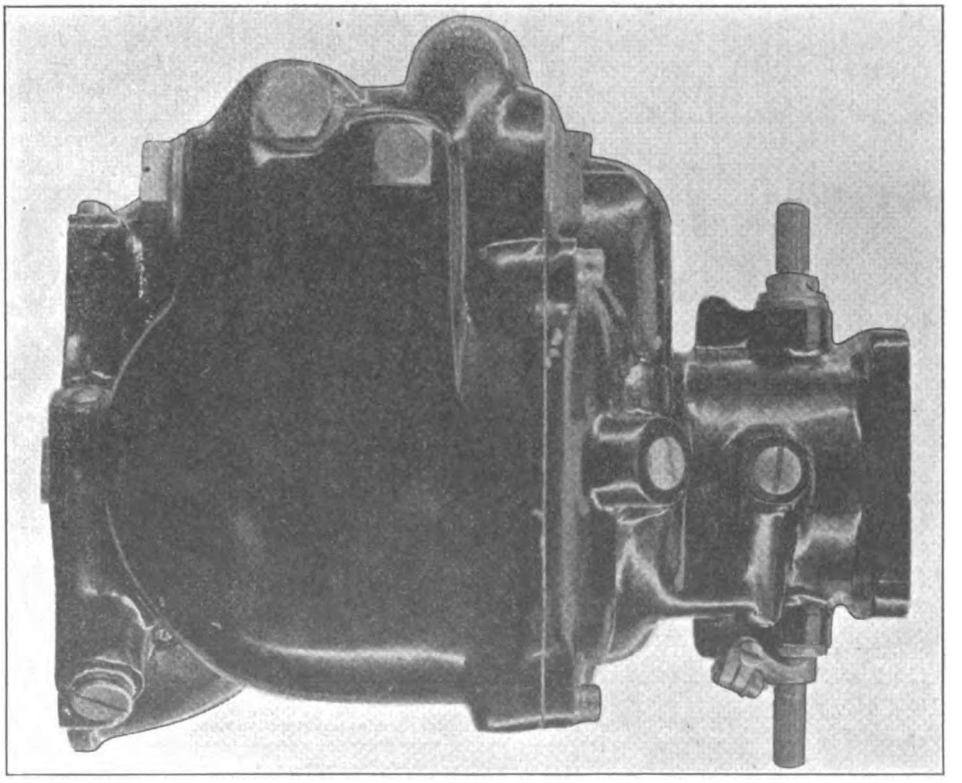

FIG. 10.—Stromberg NA-S6 carburetor. Side (floate hamber) view.

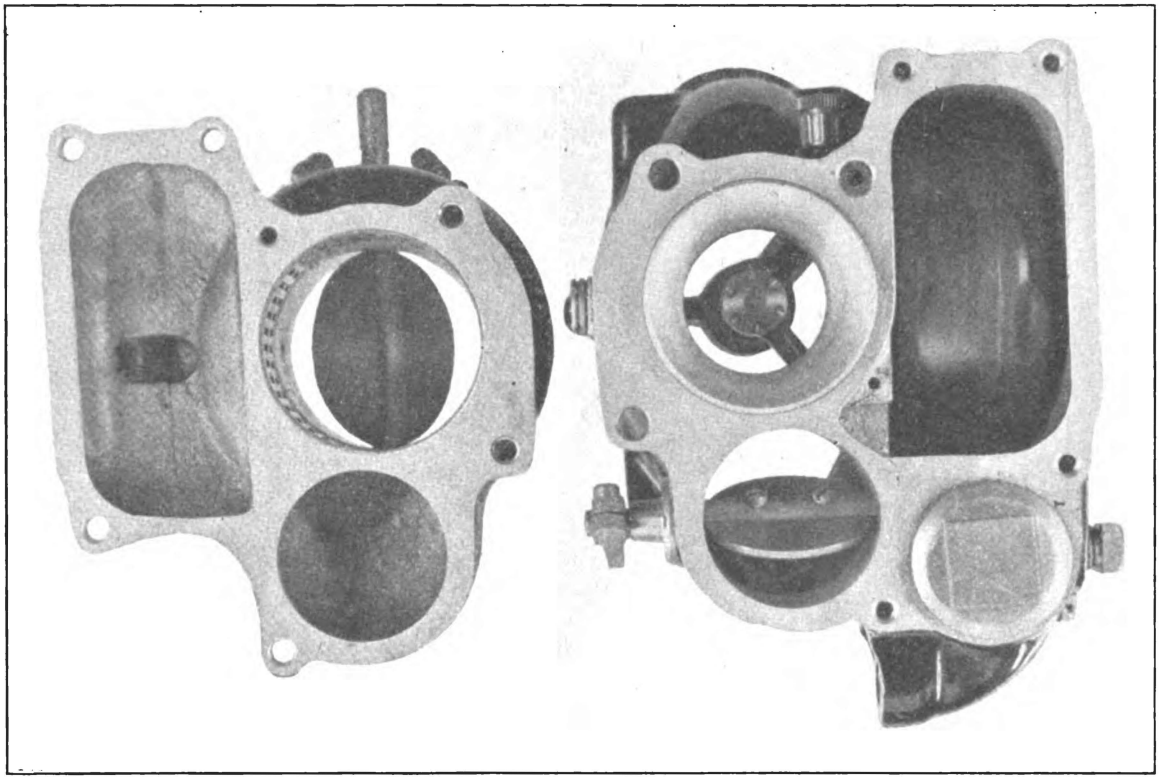

FIG. 11.—Stromberg NA-S6 carburetor. Sectional view.

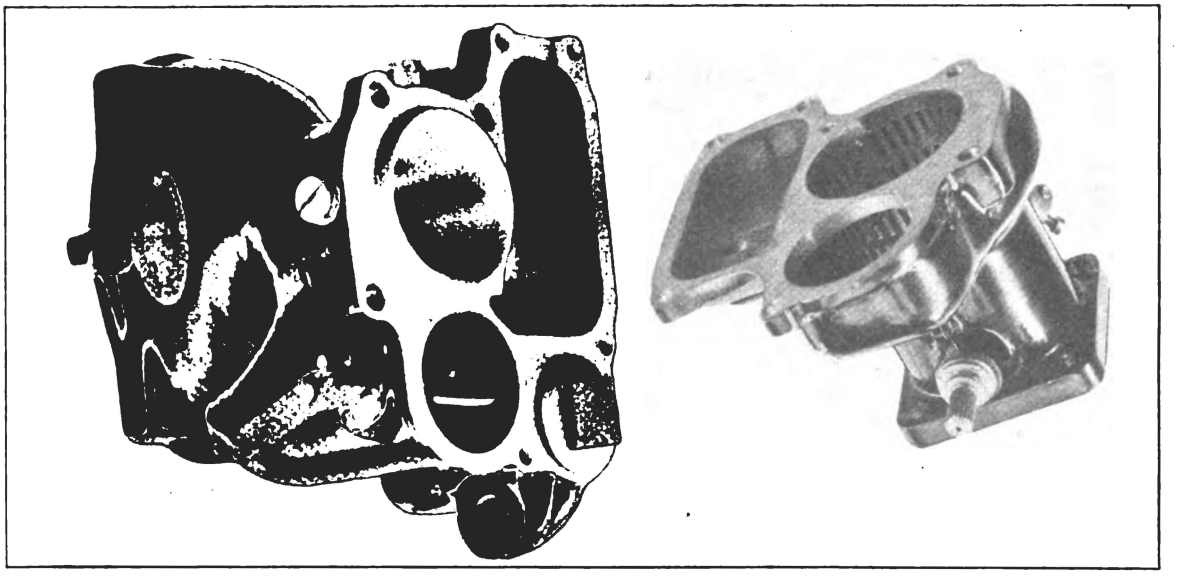

FIG. 12.—Stromberg NA-S6 carburetor. Sectional perspective view.

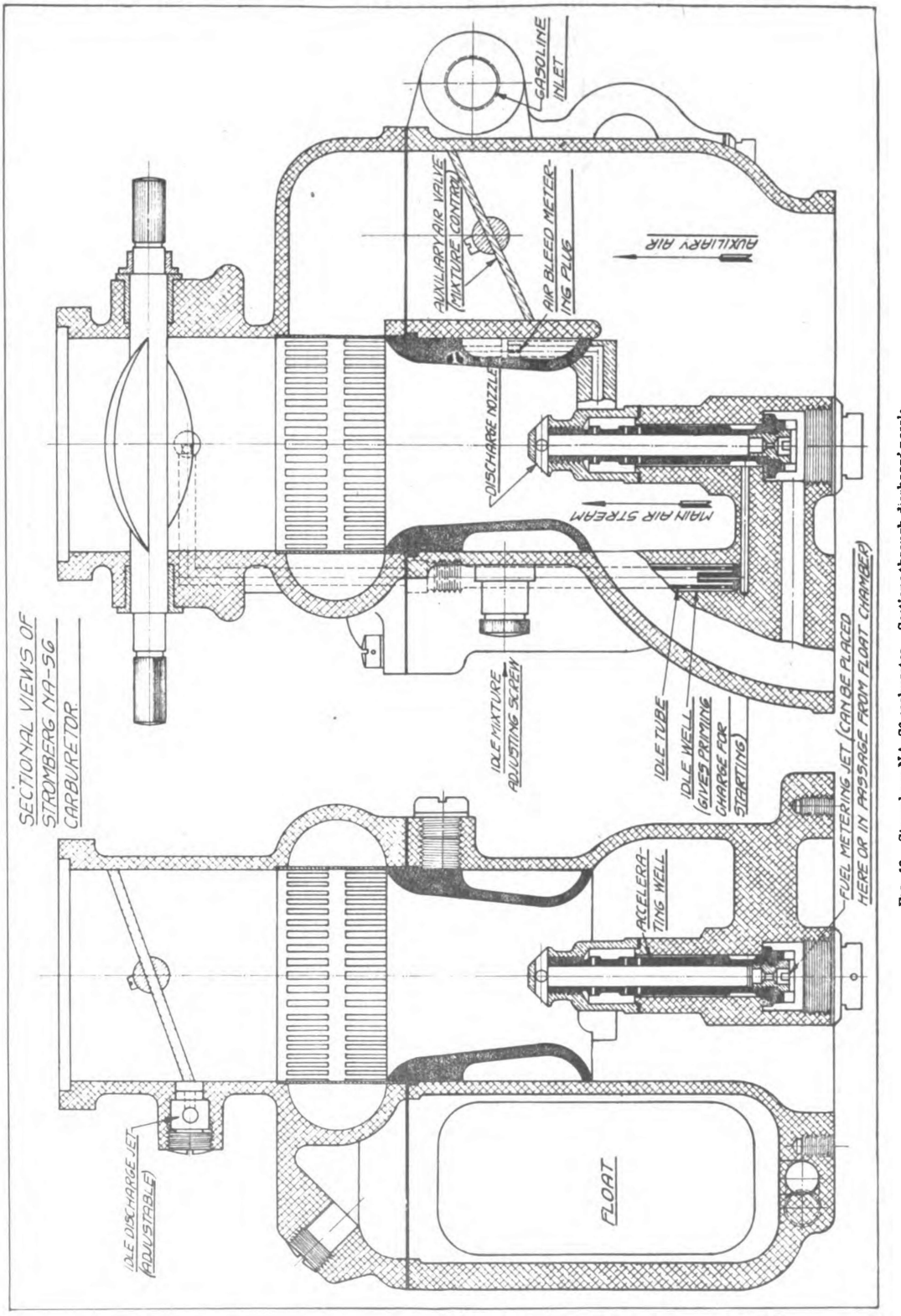

FIG. 13.—Stromberg NA-S6 carburetor. Sections through discharge nozzle.

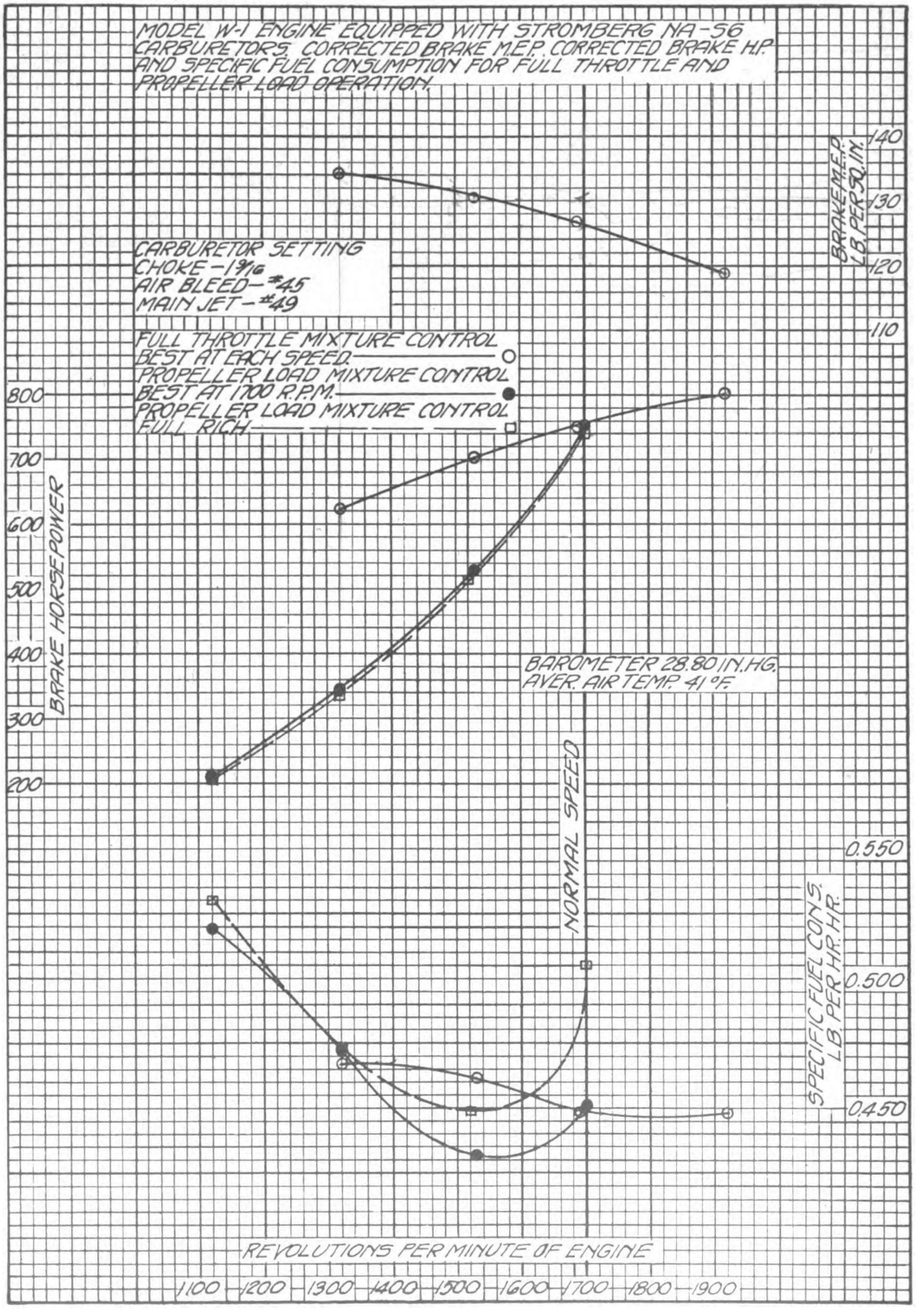

FIG. 14.

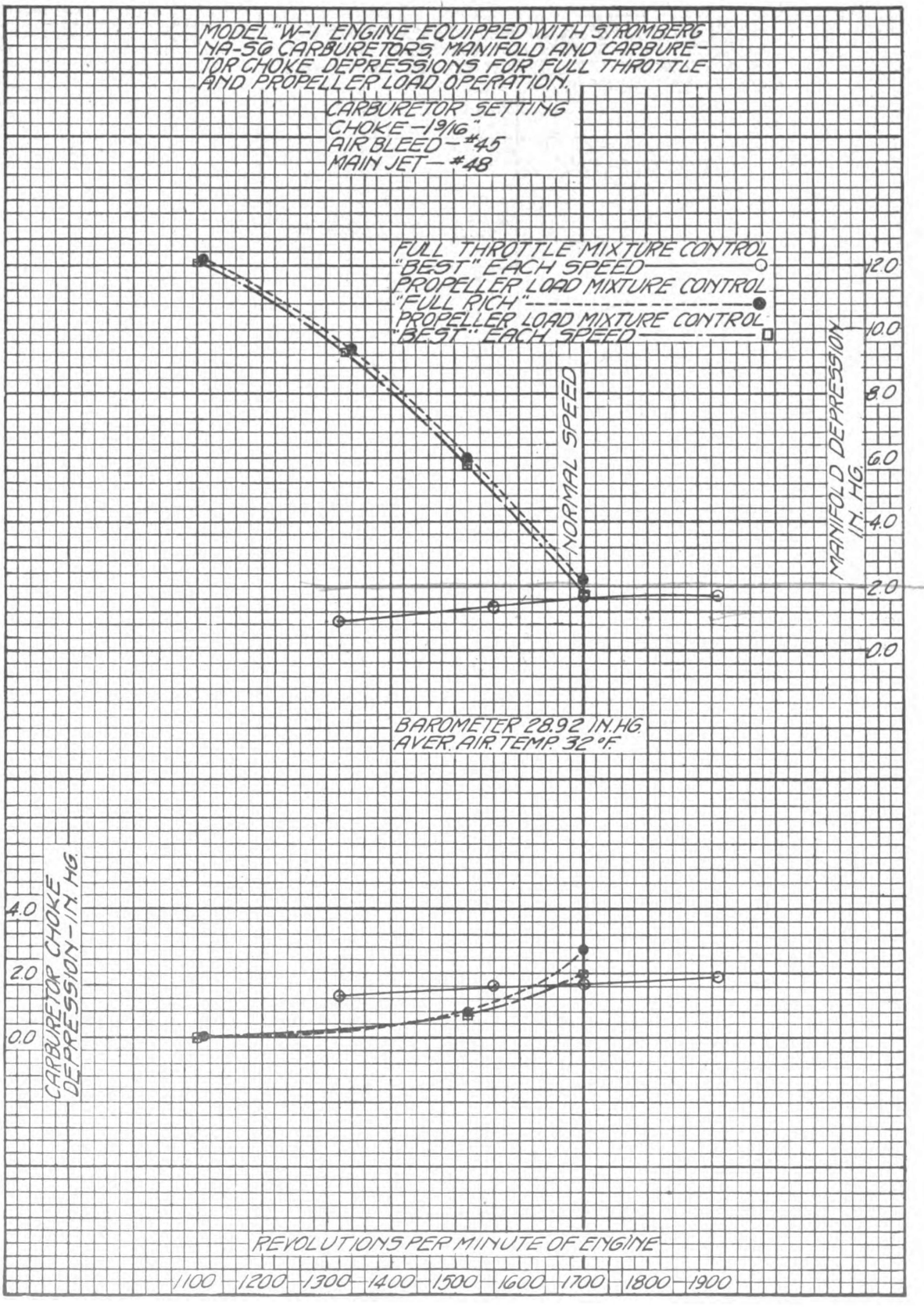

FIG. 15.

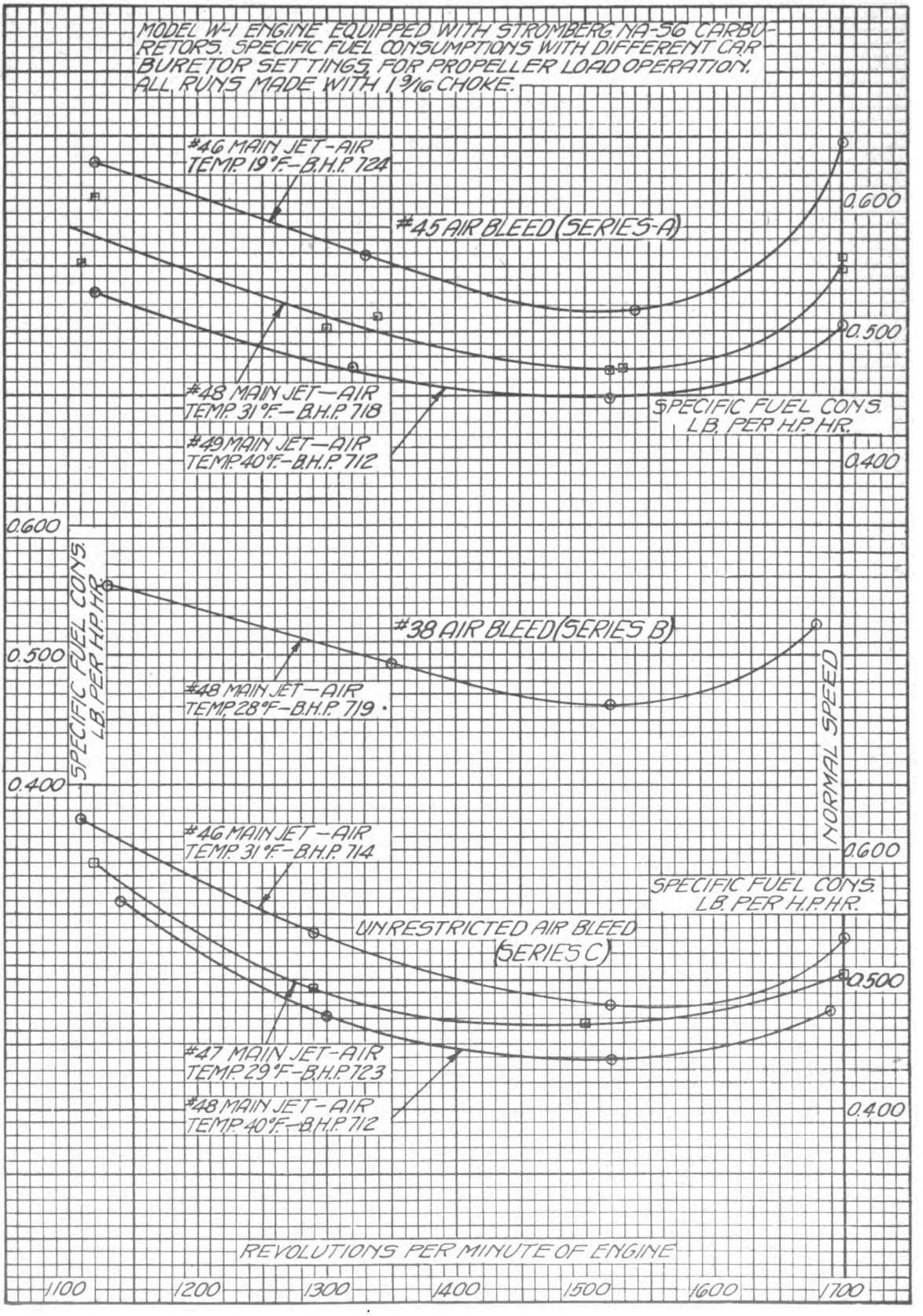

FIG. 16.

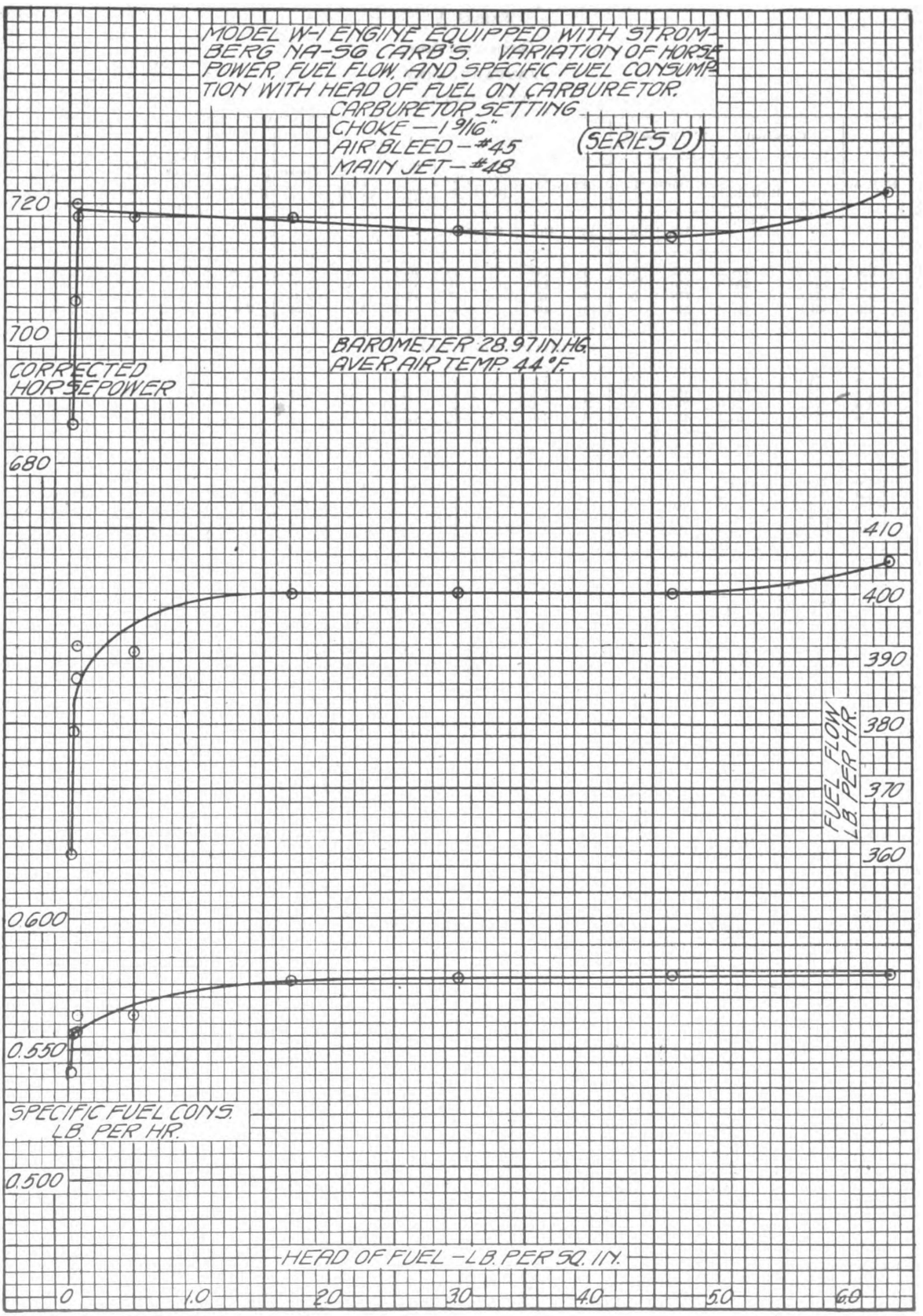

FIG. 17.

SERIES A.

Carburetion runs.

JANUARY 11, 1922.

FULL POWER.

R. P. M.	Corrected.		Water.		Oil.				Carb. air temp., °F.	Man. vac., in. hg.	Choke vac., in. hg.	Mix. cont. position.	Float chamber vac., in. H_2O.	Throttle position.	Fuel cons. lb. per H. P. hr.
	H. P.	B. M. E. P., lbs. per sq. in.	Temp., °F.		Temp., °F.		Press., lbs. per sq. in.								
			In.	Out.	In.	Out.	M.	C. S.							
1,320	623.0	134.5	147	170	94	144	55	50	40.0	1.0	1.55	3.00	0.0	8.25	0.467
1,530	702.0	130.6	150	170	94	150	55	47	41.0	1.45	1.90	3.00	0	8.25	.462
1,690	752.0	126.7	153	169	96	158	55	47	42.5	1.8	2.10	2.90	0	8.25	.448
1,920	801.0	118.7	148	169	102	166	54	45	41.5	1.9	2.50	2.65	0	8.25	.448

STANDARD PROPELLER LOAD.

1,700	754.0	126.3	151	170	96	146	56	50	40.0	1.7	2.1	2.95	0.0	8.25	0.451
1,530	528.0	98.3	152	167	96	156	54	45	41.0	3.7	.8	2.95	−.2	5.60	.432
1,320	343.0	74.0	156	169	96	150	55	52	41.0	6.4	.3	2.95	−.4	4.50	.472
1,120	209.0	53.1	155	170	96	140	55	55	41.0	9.7	.1	2.95	−.5	3.70	.519

FULL RICH AND BEST SETTING PROPELLER LOAD.

1,700	740.0	124.0	151	168	94	146	55	48	42.0	2.1	2.8	F. R.	0.5	8.25	0.505
1,690	749.0	126.2	151	172	94	158	54	46	40.0	1.8	2.1	2.85	0	8.25	.449
1,520	517.5	97.0	150	173	96	158	54	43	40.0	5.2	.9	F. R.	−.2	5.00	.449
1,490	503.0	96.2	154	174	96	156	54	47	40.0	5.5	1.15	2.20	−.2	5.00	.444
1,320	336.5	72.6	153	170	96	150	54	50	40.0	9.9	.2	F. R.	−.2	4.25	.473
												F. R.			
1,120	204.0	51.8	154	168	96	142	55	51	41.0	13.1	.1	F. R.	−.7	3.60	.530
												F. R.			

Carburetor settings:
Carburetor used, Stromberg NA-S6.
Chokes, $1\frac{5}{16}$ inches.
Main jets, No. 49.
Air bleed, No. 45.
Barometer, 28.80 in. hg.

Remarks:
Mixture control has 10 divisions.
F. R.=full rich=2.00.
F. L.=full lean=6.00.
Throttle has 10 divisions.
Closed=0.4.
Open=8.25.
Oil pressure—
M=main at pump.
C. S.=in cam-shaft housing.

JANUARY 12, 1922.

FULL POWER.

R. P. M.	Corrected.		Water.		Oil.			Carb. air temp., °F.	Man. vac., in hg.	Choke vac., in hg.	Mix. cont. position.	Float chamber vac., in H_2O.	Throttle position.	Fuel cons. lb. per H. P. hr.
	H. P.	B. M. E. P., lbs. per sq. in.	Temp., °F.		Temp., °F.		Press., lbs. per sq. in.							
			In.	Out.	In.	Out.								
1,320	628.0	135.4	140	170	108	142	54	34	0.9	1.3	3.55	0.1	8.25	0.478
1,560	726.0	132.5	150	170	108	150	54	30	1.4	1.6	3.60	.2	8.25	.450
1,700	752.0	127.8	150	172	110	158	54	36	1.65	1.7	3.50	.3	8.25	.447
1,910	804.0	120.0	.....	.....	.....	.....	55	34	1.70	1.9	3.40	.3	8.25	.450

STANDARD PROPELLER LOAD.

1,720	772.0	127.8	150	170	101	146	54	31	1.8	2.2	2.70	1.0	8.25	0.491
1,530	528.0	98.3	152	170	104	150	54	34	5.0	.6	2.70	.0	5.25	.440
1,320	340.0	73.3	153	170	104	146	53	30	8.7	.3	2.70	−.5	4.25	.482
1,100	198.5	51.4	156	170	104	138	52	30	11.8	[1]1.3	2.70	−.2	3.20	.534

FULL-RICH AND BEST-SETTING PROPELLER LOAD.

1,700	742.0	124.2	154	168	102	142	53	31	2.2	2.75	F. R.	0.9	8.25	0.557
1,700	767.0	128.5	152	170	104	152	55	35	1.75	2.0	3.00	−.2	8.25	.465
1,520	522.0	97.8	153	170	108	154	54	30	6.0	.8	F. R.	−.5	5.00	.470
1,520	515.0	96.5	152	170	109	152	53	31	5.8	.7	2.40	−.3	5.00	.460
1,340	343.0	73.0	154	170	110	148	53	31	9.4	.25	F. R.	−1.0	4.15	.511
1,330	339.0	72.6	154	170	108	142	52	32	9.3	[1]3.2	2.35	−.5	4.15	.478
1,110	206.0	52.8	156	170	106	138	52	31	12.2	0.0	F. R.	−1.6	3.65	.552
1,100	203.0	52.5	158	168	104	132	52	30	12.1	[1].8	2.40	−.7	3.65	.532

[1] In. H_2O.

Carburetor settings:
Carburetor used, NA-S6.
Chokes, $1\frac{5}{16}$ inches.
Main jets, No. 48.
Air bleed, No. 45.
Barometer, 28.92 in. hg.

Remarks:
Mixture control has 10 divisions.
F. R.=full rich=2.00.
F. L.=full lean=6.00.
Throttle has 10 divisions.
Closed=0.4.
Open=8.25.

SERIES A—Continued.

Propeller-load runs.

JANUARY 12, 1922.

R. P. M.	Corrected.		Water.		Oil.				Carb. air temp. °F.	Man. vac., in. hg.	Choke vac., in. hg.	Mixture control position.	Fuel cons., lb. per H. P. hr.
	H. P.	B. M. E. P., lbs. per sq. in.	Temp., °F.		Temp., °F.		Press., lbs. per sq. in.						
			In.	Out.	In.	Out.	M.	C. S.					
1,700..	746	125.0	154	173	92	130	55	38	34	2.2	2.8	F. R....	0.548
1,530..	522	97.2	151	167	98	140	54	40	30	6.0	.85	F. R....	.471
1,300..	330	72.3	160	170	100	140	53	43	29	9.5	.25	F. R....	.502
1,120..	206	52.4	158	168	100	136	.....	.....	30	12.2	.10	F. R....	.603

Carburetor settings:
Carburetor used, Stromberg NA-S6.
Chokes, 1 5/8 inches.
Main jets, No. 48.
Air bleed, No. 45.
Barometer, 28.95 in. hg.

Remarks:
Mixture control has 10 divisions.
F. R.—full rich—2.00.
F. L.—full lean—6.00.
Oil pressure—
M.—main at pump.
C. S.—in cam-shaft housing.

JANUARY 23, 1922.

R. P. M.	Corrected.		Water.		Oil.			Carb. air temp. °F.	Man. vac., in. hg.	Choke vac., in. hg.	Mixture control position.	Fuel cons., lb. per H. P. hr.
	H. P.	B. M. E. P., lbs. per sq. in.	Temp., °F.		Temp., °F.		Press., lbs. per sq. in.					
			In.	Out.	In.	Out.						
1,700	730	122.2	154	170	106	134	52	20	2.2	2.8	F. R.	0.646
1,540	520	96.2	152	172	108	136	51	18	5.9	.9	F. R.	.516
1,330	333	71.3	150	170	110	136	50	18	9.0	.35	F. R.	.559
1,120	201	51.1	150	168	108	134	49	18	11.7	.20	F. R.	.630

Carburetor settings:
Carburetor used, Stromberg NA-S6.
Chokes, 1 5/8 inches.
Main jets, No. 46.
Air bleed, No. 45.

Barometer, 29.69 in. hg.
Remarks:
Mixture control has 10 divisions.
F. R.—full rich—2.00.
F. L.—full lean—6.00.

SERIES B.—*Propeller-load run.*

R. P. M.	Corrected.		Water.		Oil.			Carb. air temp. °F.	Man. vac., in. hg.	Choke vac., in. hg.	Mixture control position.	Fuel cons., lb. per H. P. hr.
	H. P.	B. M. E. P., lbs. per sq. in.	Temp., °F.		Temp., °F.		Press., lbs. per sq. in.					
			In.	Out.	In.	Out.						
1,680	735.0	124.5	147	166	116	136	52	29	2.05	2.7	F. R.	0.524
1,520	522.0	97.8	146	166	120	146	50	27	5.1	.95	F. R.	.461
1,350	346.0	73.0	151	170	120	144	50	28	8.5	.35	F. R.	.493
1,130	205.5	51.8	150	167	120	140	50	27	11.7	.15	F. R.	.554

Carburetor settings:
Carburetor used, Stromberg NA-S6.
Chokes, 1 5/8 inches.
Main jets, No. 48.
Air bleed, No. 38.
Barometer, 29.27 in. hg.

Remarks:
Mixture control has 10 divisions.
F. R.—full rich—2.00.
F. L.—full lean—6.00.
Date, Jan. 19, 1922.

SERIES C.—*Propeller-load runs.*

WITH No. 48 MAIN JETS.

R. P. M.	Corrected.		Water.		Oil.			Carb. air temp., °F.	Man. vac., in. hg.	Choke vac., in. hg.	Mixture control position.	Fuel cons., lbs. per H. P. hr.
	H. P.	B. M. E. P., lbs. per sq. in.	Temp., °F.		Temp., °F.		Press., lbs. per sq. in.					
			In.	Out.	In.	Out.						
1,670	701	119.5	153	174	106	156	52	52	2.1	2.85	F. R.	0.487
1,520	518	97.1	152	171	102	158	52	50	4.7	1.1	F. R.	.439
1,300	329	72.1	152	171	96	152	52	40	8.4	.25	F. R.	.471
1,140	206	51.4	150	168	96	144	52	39	11.6	.2	F. R.	.560
Check.												
1,690	728	122.6	149	160	90	144	52	39	2.1	2.8	F. R.	.477

WITH No. 47 MAIN JETS.

1,700	740.0	124.0	152	170	104	134	53	30	2.2	2.7	F. R.	0.505
1,500	508.0	96.6	151	170	106	138	53	29	6.0	.65	F. R.	.467
1,290	322.0	71.1	152	172	108	136	52	29	11.6	.25	F. R.	.493
1,120	202.5	51.5	146	164	108	136	51	29	16.4	.....	F. R.	.590

WITH No. 46 MAIN JETS.

1,700	730.0	122.4	150	170	96	130	51	32	2.1	2.6	F. R.	0.531
1,520	518.0	97.1	152	172	100	140	51	31	5.5	.8	F. R.	.480
1,290	325.0	71.7	152	172	106	140	51	30	9.8	.45	F. R.	.535
1,110	202.5	52.0	150	169	106	138	51	31	13.5	.....	F. R.	.624

Carburetor settings:
Carburetor used, Stromberg NA-S6.
Chokes, $1\frac{7}{8}$ inches.
Air bleed, unrestricted.
Barometer, 29.25 in. hg.

Remarks:
Mixture control has 10 divisions.
F. R.=full rich=2.00.
F. L.=full lean=6.00.
Date, Jan. 20 and 21, 1922.

SERIES D.—*Carburetor-head test.*

R. P. M.	Corrected.		Water.		Oil.			Carb. air temp., °F.	Man. vac., in. hg.	Choke vac., in. hg.	Mixture control position.	Fuel head on carb., in. gas.	Float chamber vac., in. H_2O.	Fuel cons., lb. per H. P. hr.
	H. P.	B. M. E. P., lbs. per sq. in.	Temp., °F.		Temp., °F.		Press., lbs. per sq. in.							
			In.	Out.	In.	Out.								
1,680	718	121.7	148	169	114	154	53	.....	2.1	2.8	F. R.	2.8	1.1	0.557
1,670	705	120.2	154	176	104	142	52	44	2.1	2.8	F. R.	2.0	.3	.556
1,640	686	119.2	150	172	112	154	52	45	2.0	2.8	F. R.	1.2	4.4	.542
1,690	720	121.3	152	172	112	150	53	.....	2.1	2.8	F. R.	3.0	1.1	.563
1,680	718	121.7	139	160	114	154	52	42	2.0	2.8	F. R.	19.8	.4	.563
1,680	718	121.7	142	162	114	146	54	.....	2.1	2.65	F. R.	[1] 3.5	.5	.576
1,680	716	121.4	146	166	118	156	52	44	2.1	2.7	F. R.	[1] 6.2	.6	.577
1,670	715	121.8	146	168	118	158	52	43	2.05	2.7	F. R.	[1] 9.5	.4	.578
1,690	722	121.6	148	169	120	160	53	43	2.1	2.7	F. R.	[1] 12.9	.3	.579

[1] Inches of hg.

Carburetor settings:
Carburetor used, NA-S6 Stromberg.
Chokes, $1\frac{1}{8}$ inches.
Main jets, No. 48.

Carburetor settings (continued):
Air bleed, No. 45.
Barometer, 28.97 in. hg.
Date, Jan., 18, 1922.

SERIES D.—*Data of flooding test of 5 NA-S6 Carburetors.*

Carburetor No.	Flooding pressure.		Remarks.
	In. hg.	Lbs. per sq. in.	
1.....	6.8	3.33	After commencement of flooding runs a continuous stream.[1]
2.....	12.6	6.18	After commencement of flooding drips only a small amount.
3.....	12.6	6.18	Do.
4.....	13.5	6.62	Do.
5.....	19.3	9.46	Do.

[1] The float of No. 1 curburetor was found to be in a collapsed condition and after repair the carburetor would stand a pressure of over 6 pounds per square inch before flooding commenced.

Date, Jan. 18, 1922.

SERIES E.—*Flooding test of carburetors at torque stand. Engine A. S. No. 94626. Carburetors NA-S6B.*

FLOODING PRESSURE.

Carburetor No.	Engine idling 375–500 R. P. M.		Engine not running.		Engine idling 400–450 R. P. M.	
	Ins. hg.	Lbs. per sq. in.	Ins. hg.	Lbs. per sq. in.	Ins. hg.	Lbs. per sq. in.
1L.....	32.5	15.9	18.2	8.9	.....	.....
1R.....	.....	.....	14.8	7.3	.....	.....
2L.....	.....	.....	12.8	6.3	.....	.....
2R.....	17.8	8.7	16.8	8.2	.....	.....
3L.....	.....	.....	16.3	8.0	.....	.....
3R.....	.....	.....	17.8	8.7	30.8	15.1

NOTE.—The apparatus limited the pressure obtainable to 33.5 in. hg. (16.3 lbs. per sq. in.), and where there are no figures in the above table it indicates that the carburetors had not flooded when this limit was reached.

Date, Mar. 7, 1922.

SERIES F.

Full-power heat rejection.

FIRST RUN.

R. P. M.	Corrected.		Water.				Oil.			Carb. air temp., °F.	Man. vac., in. hg.	Choke vac., in. hg.	Mixture control position.	Fuel cons., lbs. per H. P. hr.
			Temp., °F.				Temp., °F.							
	H. P.	B. M. E. P. lbs. per sq. in.	Before.		After.		In.	Out.	Press., lbs. per sq. in.					
			In.	Out.	In.	Out.								
1,640	728	126.5	147	168	144.5	165.5	106	156	55	48	1.9	1.9	3.00	0.490
1,680	739	125.4	145	167	148.5	170.0	110	164	54	49	1.9	1.8	3.00	.480
1,830	766	119.2	149.5	171	150	171.5	112	170	55	49	1.95	1.9	3.00	.466

SECOND RUN.

1,630	720	125.7	146	168.5	152	175.0	96	156	54	49	1.8	1.85	3.00	0.484
1,680	736	124.7	154	176.5	152	174.0	96	160	55	51	1.85	1.9	3.00	.485
1,810	742	116.7	151.5	173.0	151	172.5	96	168	53	51	1.9	2.2	2.75	.496

Carburetor settings:
Carburetor used, NA-86.
Chokes, 1⅛ inches.
Main jets, No. 48.
Air bleed, No. 45.
Barometer, 28.91 in. hg.
Remarks:
Mixture control—
F. L.=full lean=6.00.
F. R=full rich=2.00.

Data for all runs in this report:
Dynamometer, No. 3.
Length of brake arm, 21 in.
Kind of oil used—Spec. 2-23 (grade 3).
Viscosity 115°–125° S. at 210° F.
Fuel used, spec. gravity .705 at 60° F.

Date, Jan. 18, 1922.

Summary of model W-1 heat-rejection data (corrected).

RUN NO. 1.

R. P. M.	Engine actual B. H. P.	Air temp., °F.	Cooling water.					Corr. water temp., °F.			B. T. U. per min. rejected to water.	
			Venturi No. 1.		Venturi No. 2.		Total.					
			Corr. head, in. hg.	Flow, lbs. per hr.	Corr. head, in. hg.	Flow, lbs. per hr.	Flow, lbs. per hr.	In.	Out.	Diff.	Total.	Per actual B. H. P.
1,640	703	48	10.9	32,400	4.4	21,100	53,500	143.9	164.3	20.4	18,200	25.9
1,680	714	49	11.25	33,000	3.55	19,000	52,000	144.9	166.0	21.1	18,290	26.0
1,830	740	49	11.85	33,850	3.65	19,250	53,100	147.8	168.7	20.9	18,500	25.0

RUN NO. 2.

1,630	695	49	27.7	51,850	.....	.....	51,850	147.0	169.2	22.2	19,180	27.6
1,680	711	51	29.05	53,150	.....	.....	53,150	150.9	172.7	21.8	19,310	27.15
1,810	716	51	32.10	56,000	.....	.....	56,000	149.2	170.2	21.0	19,600	27.35

Barometer, 28.91 in. hg.